Amendments to the Claims:

The following listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Previously Presented) Method for processing a signal (y(t)) sent over a wireless communication channel, comprising sampling the received signal (y(t)) with a sampling frequency (f_s) lower than the sampling frequency given by the Shannon theorem, lower than the chip rate ($1/T_c$) of said received signal (y(t)), but greater than the rate of innovation (ρ) of said received signal (y(t)), for generating a set of sampled values ($y(nT_s)$).

2. (Previously Presented) Method according to claim 1, further comprising filtering said received signal (y(t)) with a filter (f).

3. (Original) Method according to claim 2, wherein said filter (f) is a lowpass filter.

4. (Original) Method according to claim 3, wherein said filter (f) is a sinc filter.

5. (Original) Method according to claim 3, wherein said filter (f) is a Gaussian filter.

6. (Previously Presented) Method according to claim 1, wherein said wireless communication channel comprises a multipath fading transmission channel (c).

7. (Previously Presented) Method according to claim 1, wherein said wireless communication channel comprises a CDMA channel.

8. (Previously Presented) Method according to claim 1, wherein said sampling frequency ($1/T_s$) is greater than the information rate (K/T_b) of said received signal (y(t)).

9. (Previously Presented) Method according to claim 1, wherein said sent signal ($y(t)$) includes a plurality of training sequences (b_{kt}) each encoded with a user specific coding sequence ($s_k(t)$) and transmitted by said users (k), said method further comprising:

computing a set of spectral values ($Y[m]$) corresponding to said received signal ($y(t)$) from said set of sampled values ($y(nT_s)$),

recovering spectral values ($S_k[m]$) corresponding to each of said user specific coding sequence ($s_k(t)$),

retrieving the delays ($\tau_k^{(l)}$) and the amplitude attenuations ($a_k^{(l)}$) induced by said communication channel on said sent signal ($y(t)$), from said set of spectral values ($Y[m]$) corresponding to said received signal ($y(t)$) and from said spectral values ($S_k[m]$) corresponding to each of said user specific coding sequence ($s_k(t)$).

10. (Previously Presented) Method according to claim 9, wherein retrieving said delays ($\tau_k^{(l)}$) and said amplitude attenuations ($a_k^{(l)}$) includes solving a series of one-dimensional estimation problems, the size of each said one-dimensional estimation problem being equal to the number of said sampled values ($y(nT_s)$) generated during one symbol duration (T_b).

11. (Original) Method according to claim 10, wherein said series of one-dimensional equation systems is derived from said spectral values ($Y[m]$) of said received signal ($y(t)$), said spectral values ($S_k[m]$) of each of said user specific coding sequence ($s_k(t)$) and the value of the bits ($b_k^{(h)}$) of said training sequences (b_{kt}).

12. (Previously Presented) Method according to claim 11, further comprising:

processing a second sent signal ($y(t)$) including a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k),

sampling said second sent signal ($y(t)$) with a sampling frequency lower than the sampling frequency given by the Shannon theorem, but greater than the rate of innovation (ρ) of said second sent signal ($y(t)$), for generating a second set of sampled values ($y(nT_s)$).

13. (Previously Presented) Method according to claim 12, further comprising running a multiuser detection scheme using said second set of sampled values ($y(nT_s)$) and previously

computed said delays ($\tau_k^{(l)}$) and said amplitude attenuations ($a_k^{(l)}$) for estimating the value of the symbol (b_k) sent by each said user (k).

14. (Original) Method according to claim 13, wherein said multiuser detection scheme is a decorrelating detection scheme.

15. (Previously Presented) Method according to claim 13, wherein said multiuser detection scheme is a minimum mean-square error detection scheme.

16. (Previously Presented) Method according to claim 1, wherein said sent signal (y(t)) includes a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k), said method further comprising:

running a multiuser detection scheme using known delays ($\tau_k^{(l)}$) and amplitude attenuations ($a_k^{(l)}$) induced by said wireless communication channel on said sent signal (y(t)) and using said set of sampled values ($y(nT_s)$) and for estimating the value of the symbol (b_k) sent by each said user (k).

17. (Original) Method according to claim 16, wherein said multiuser detection scheme is a decorrelating detection scheme.

18. (Previously Presented) Method according to claim 16, wherein said multiuser detection scheme is a minimum mean-square error detection scheme.

19. (Previously Presented) Method according to claim 1, wherein said sent signal (y(t)) includes a plurality of training sequences (b_{kt}) each encoded with a user specific coding sequence ($s_k(t)$) and transmitted by said users (k), said method further comprising:

computing a set of spectral values (Y[m]) of said received signal (y(t)) from said set of sampled values ($y(nT_s)$), computing a set of channel dependant values (C) from said set of spectral values (Y[m]) and said training sequences (b_{kt}),

processing a second sent signal (y(t)) including a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k),

sampling said second sent signal ($y(t)$) with a sampling frequency lower than the sampling frequency given by the Shannon theorem, but greater than the rate of innovation (ρ) of said second sent signal ($y(t)$), for generating a second set of sampled values ($y(nT_s)$)

retrieving the value of the symbol (b_k) sent by each said user (k) by solving a linear matrix system including said second set of sampled values ($y(nT_s)$) and said set of channel dependant values (C).

20. (Previously Presented) Method according to claim 1, wherein said sent signal ($y(t)$) includes a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k), said user specific coding sequence ($s_k(t)$) being chosen such that, when filtered with a lowpass filter (f), it is orthogonal to any other user's specific coding sequence ($s_k(t)$) used in said communication channel and filtered with said lowpass filter (f), said method further comprising:

sampling said sent signal ($y(t)$) with a sampling frequency lower than the sampling frequency given by the Shannon theorem, but greater than the rate of innovation (ρ) of said sent signal ($y(t)$), for generating a set of sampled values ($y(nT_s)$)

filtering said set of sampled values ($y(nT_s)$) with a bank of matched filters, each filter being matched to said user specific coding sequence ($s_k(t)$) filtered with said lowpass filter (f), for estimating the value of the symbol (b_k) sent by each said user (k).

21. (Previously Presented) Method according to claim 1, wherein said wireless communication channel comprises an array of antennas (i).

22. (Previously Presented) Method according to claim 21, wherein said sent signal ($y(t)$) is the superposition of a plurality of training sequences (b_{kt}) each encoded with a user specific coding sequence ($s_k(t)$) and transmitted by said users (k), said method further comprising:

sampling the received signals ($y_i(t)$) received by each antenna (i) in the antenna array with a sampling frequency (f_s) lower than the sampling frequency given by the Shannon theorem, but greater than the rate of innovation (ρ) of said received signals ($y_i(t)$), for generating sets of sampled values ($y_i(nT_s)$),

computing sets of spectral values ($Y_i[m]$) of said received signals ($y_i(t)$) from said sets of sampled values ($y_i(nT_s)$),

recovering the spectral values ($S_k[m]$) of each of said user specific coding sequence ($s_k(t)$),

retrieving the delays ($\tau_k^{(l)}$), the amplitude attenuations ($a_k^{(l)}$) and the directions of arrival ($\theta_k^{(l)}$) induced by said communication channel on said sent signal ($y(t)$) from said sets of spectral values ($Y_i[m]$) corresponding to said received signals ($y_i(t)$) and from said spectral values ($S_k[m]$) corresponding to each of said user specific coding sequence ($s_k(t)$).

23. (Previously Presented) Method according to claim 22, wherein retrieving said delays ($\tau_k^{(l)}$), said amplitude attenuations ($a_k^{(l)}$) and said directions of arrival ($\theta_k^{(l)}$) includes solving a series of two-dimensional estimation problems, the size of each said two-dimensional estimation problem being equal to the number of said sampled values ($y_i(nT_s)$) generated during one symbol duration (T_b).

24. (Original) Method according to claim 23, wherein said series of two-dimensional equation systems is derived from said spectral values ($Y_i[m]$) of said received signal ($y_i(t)$), said spectral values ($S_k[m]$) of each of said user specific coding sequence ($s_k(t)$) and the value of the bits ($b_k^{(h)}$) of said training sequences (b_{kt}).

25. (Previously Presented) Method according to claim 24, further comprising:

processing a second sent signal ($y(t)$) including a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k),

orienting the beams of said array of antennas (i) towards previously determined said arrival directions ($\theta_k^{(l)}$),

sampling said second sent signal ($y(t)$) with a sampling frequency lower than the sampling frequency given by the Shannon theorem, but greater than the rate of innovation (ρ) of said second sent signal ($y(t)$), for generating a second set of sampled values ($y(nT_s)$).

26. (Previously Presented) Method according to claim 25, further comprising running a 2D-RAKE detection scheme using said second set of sampled values ($y(nT_s)$) and previously

computed said delays ($\tau_k^{(l)}$) and said amplitude attenuations ($a_k^{(l)}$) for estimating the value of the symbol (b_k) sent by each said user (k).

27. (Previously Presented) Method according to claim 1, wherein said wireless communication channel comprises an Ultra Wideband (UWB) communication channel.

28. (Previously Presented) A computer-readable medium on which is recorded a control program for a data processor, the computer-readable medium comprising instructions for causing the data processor to:

sample a signal (y(t)) sent over a wireless communication channel with a sampling frequency (f_s) lower than the sampling frequency given by the Shannon theorem, lower than the chip rate ($1/T_c$) of said signal (y(t)), but greater than the rate of innovation (ρ) of said signal (y(t)), for generating a set of sampled values ($y(nT_s)$).

29. (Original) Receiver for decoding a signal (y(t)) sent over a bandwidth-expanding communication system according to the method of claim 1.

30. (Original) Receiver according to claim 29, comprising a memory for storing said spectral values ($S_k[m]$) of said signature sequences ($s_k(t)$).

31. (Original) Set of at least two encoders for use with a receiver according to claim 29, each encoder (50) of said set of encoders being assigned at least one training sequence (b_{kt}) to be sent over a bandwidth-expanding channel during a training phase (30), wherein said at least one training sequence (b_{kt}) is chosen such that it is linearly independent from any other training sequence (b_{kt}) assigned to any other encoder (50) of said set of encoders.

32. (Original) Set of at least two encoders according to claim 31, each said encoder (50) being assigned at least two said training sequences (b_{kt}), wherein each said encoder (50) is designed to select from said at least two training sequences (b_{kt}) the training sequence (b_{kt}) to be sent during said training phase (30).

33. (Original) Set of at least two encoders according to claim 31, each said encoder (50) further being assigned a specific coding sequence ($s_k(t)$) for coding a signal ($x(t)$) to be sent over said bandwidth-expanding channel, wherein said coding sequence ($s_k(t)$) is chosen such that, when filtered with a lowpass filter (f), it is orthogonal to any specific coding sequence ($s_k(t)$) assigned to any other encoder (50) of said set of encoders filtered with said lowpass filter (f).

34. (Previously Presented) An apparatus for processing a signal ($y(t)$) sent over a wireless communication channel, comprising:

a receiver configured to sample the received signal ($y(t)$) with a sampling frequency (f_s) lower than the sampling frequency given by the Shannon theorem, lower than the chip rate ($1/T_c$) of said received signal ($y(t)$), but greater than the rate of innovation (ρ) of said received signal ($y(t)$), for generating a set of sampled values ($y(nT_s)$).

35. (Previously Presented) The apparatus of claim 34, further comprising a filter configured to filter the received signal ($y(t)$).

36. (Previously Presented) The apparatus of claim 35, wherein said filter is a lowpass filter.

37. (Previously Presented) The apparatus of claim 36, wherein said filter is a sinc filter.

38. (Previously Presented) The apparatus of claim 36, wherein said filter is a Gaussian filter.

39. (Previously Presented) The apparatus of claim 38, wherein said wireless communication channel comprises a multipath fading transmission channel.

40. (Previously Presented) The apparatus of claim 34, wherein said wireless communication channel comprises a CDMA channel.

41. (Previously Presented) The apparatus of claim 34, wherein said sampling frequency ($1/T_s$) is greater than the information rate (K/T_b) of said received signal ($y(t)$).

42. (Previously Presented) The apparatus of claim 34, wherein said sent signal ($y(t)$) includes a plurality of training sequences (b_{kt}) each encoded with a user specific coding sequence ($s_k(t)$) and transmitted by said users, said apparatus further comprising:

a computing device configured to compute a set of spectral values ($Y[m]$) corresponding to said received signal ($y(t)$) from said set of sampled values ($y(nT_s)$); and

a processing device configured to recover spectral values ($S_k[m]$) corresponding to each of said user specific coding sequence ($s_k(t)$), and recover the delays ($\tau_k^{(l)}$) and the amplitude attenuations ($a_k^{(l)}$) induced by said communication channel on said sent signal ($y(t)$), from said set of spectral values ($Y[m]$) corresponding to said received signal ($y(t)$) and from said spectral values ($S_k[m]$) corresponding to each of said user specific coding sequence ($s_k(t)$).

43. (Previously Presented) The apparatus of claim 42, wherein the processing device is further configured to solve a series of one-dimensional estimation problems, the size of each said one-dimensional estimation problem being equal to the number of said sampled values ($y(nT_s)$) generated during one symbol duration (T_b).

44. (Previously Presented) The apparatus of claim 43, wherein said series of one-dimensional equation systems is derived from said spectral values ($Y[m]$) of said received signal ($y(t)$), said spectral values ($S_k[m]$) of each of said user specific coding sequence ($s_k(t)$) and the value of the bits ($b_k^{(h)}$) of said training sequences (b_{kt}).

45. (Previously Presented) The apparatus of claim 44, wherein the receiver is further configured to process a second sent signal ($y(t)$) including a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k), and sample said second sent signal ($y(t)$) with a sampling frequency lower than the sampling frequency given by the Shannon theorem, but greater than the rate of innovation (ρ) of said second sent signal ($y(t)$), for generating a second set of sampled values ($y(nT_s)$).

46. (Previously Presented) The apparatus of claim 45, wherein the receiver is further configured to run a multiuser detection scheme using said second set of sampled values ($y(nT_s)$)

and previously computed said delays ($\tau_k^{(l)}$) and said amplitude attenuations ($a_k^{(l)}$) for estimating the value of the symbol (b_k) sent by each said user (k).

47. (Previously Presented) The apparatus of claim 46, wherein said multiuser detection scheme is a decorrelating detection scheme.

48. (Previously Presented) The apparatus of claim 46, wherein said multiuser detection scheme is a minimum mean-square error detection scheme.

49. (Previously Presented) The apparatus of claim 34, wherein said sent signal (y(t)) includes a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k), and

wherein the receiver is further configured to run a multiuser detection scheme using known delays ($\tau_k^{(l)}$) and amplitude attenuations ($a_k^{(l)}$) induced by said communication channel on said sent signal (y(t)) and using said set of sampled values ($y(nT_s)$) and for estimating the value of the symbol (b_k) sent by each said user (k).

50. (Previously Presented) The apparatus of claim 49, wherein said multiuser detection scheme is a decorrelating detection scheme.

51. (Previously Presented) The apparatus of claim 49, wherein said multiuser detection scheme is a minimum mean-square error detection scheme.

52. (Previously Presented) The apparatus of claim 34, wherein said sent signal (y(t)) includes a plurality of training sequences (b_{kt}) each encoded with a user specific coding sequence ($s_k(t)$) and transmitted by said users (k), said apparatus further comprising:

a computing device configured to compute a set of spectral values (Y[m]) of said received signal (y(t)) from said set of sampled values ($y(nT_s)$); and

a processing device configured to compute a set of channel dependant values (C) from said set of spectral values (Y[m]) and said training sequences (b_{kt}),

wherein the receiver is further configured to process a second sent signal ($y(t)$) including a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k), sample said second sent signal ($y(t)$) with a sampling frequency lower than the sampling frequency given by the Shannon theorem, but greater than the rate of innovation (ρ) of said second sent signal ($y(t)$), for generating a second set of sampled values ($y(nT_s)$), and retrieve the value of the symbol (b_k) sent by each said user (k) by solving a linear matrix system including said second set of sampled values ($y(nT_s)$) and said set of channel dependant values (C).

53. (Previously Presented) The apparatus of claim 34, wherein said sent signal ($y(t)$) includes a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k), said user specific coding sequence ($s_k(t)$) being chosen such that, when filtered with a lowpass filter (f), it is orthogonal to any other user's specific coding sequence ($s_k(t)$) used in said communication channel and filtered with said lowpass filter (f), and wherein the receiver is further configured to sample said sent signal ($y(t)$) with a sampling frequency lower than the sampling frequency given by the Shannon theorem, but greater than the rate of innovation (ρ) of said sent signal ($y(t)$), for generating a set of sampled values ($y(nT_s)$), the apparatus further comprising:

a bank of matched filters configured to filter said set of sampled values ($y(nT_s)$), each filter being matched to said user specific coding sequence ($s_k(t)$) filtered with said lowpass filter (f), for estimating the value of the symbol (b_k) sent by each said user (k).

54. (Previously Presented) The apparatus of claim 34, wherein said communication channel comprises an array of antennas (i).

55. (Previously Presented) The apparatus of claim 54, wherein said sent signal ($y(t)$) is the superposition of a plurality of training sequences (b_{kt}) each encoded with a user specific coding sequence ($s_k(t)$) and transmitted by said users (k), and wherein the receiver is further configured to sample the received signals ($y_i(t)$) received by each antenna (i) in the antenna array with a sampling frequency (f_s) lower than the sampling frequency given by the Shannon theorem, but

greater than the rate of innovation (ρ) of said received signals ($y_i(t)$), for generating sets of sampled values ($y_i(nT_s)$), the apparatus further comprising:

a computing device configured to compute sets of spectral values ($Y_i[m]$) of said received signals ($y_i(t)$) from said sets of sampled values ($y_i(nT_s)$); and

a processing device configured to recover the spectral values ($S_k[m]$) of each of said user specific coding sequence ($s_k(t)$), and retrieve the delays ($\tau_k^{(l)}$), the amplitude attenuations ($a_k^{(l)}$) and the directions of arrival ($\theta_k^{(l)}$) induced by said communication channel on said sent signal ($y(t)$) from said sets of spectral values ($Y_i[m]$) corresponding to said received signals ($y_i(t)$) and from said spectral values ($S_k[m]$) corresponding to each of said user specific coding sequence ($s_k(t)$).

56. (Previously Presented) The apparatus of claim 55, wherein the processing device is further configured to solve a series of two-dimensional estimation problems, the size of each said two-dimensional estimation problem being equal to the number of said sampled values ($y_i(nT_s)$) generated during one symbol duration (T_b).

57. (Previously Presented) The apparatus of claim 56, wherein said series of two-dimensional equation systems is derived from said spectral values ($Y_i[m]$) of said received signal ($y_i(t)$), said spectral values ($S_k[m]$) of each of said user specific coding sequence ($s_k(t)$) and the value of the bits ($b_k^{(h)}$) of said training sequences (b_{kt}).

58. (Previously Presented) The apparatus of claim 57, wherein the receiver is further configured to process a second sent signal ($y(t)$) including a plurality of symbols (b_k) each encoded with said user specific coding sequence ($s_k(t)$) and transmitted by said users (k), orient the beams of said array of antennas (i) towards previously determined said arrival directions ($\theta_k^{(l)}$), and sample said second sent signal ($y(t)$) with a sampling frequency lower than the sampling frequency given by the Shannon theorem, but greater than the rate of innovation (ρ) of said second sent signal ($y(t)$), for generating a second set of sampled values ($y(nT_s)$).

59. (Previously Presented) The apparatus of claim 58, wherein the receiver is further configured to run a 2D-RAKE detection scheme using said second set of sampled values ($y(nT_s)$)

and previously computed said delays ($\tau_k^{(l)}$) and said amplitude attenuations ($a_k^{(l)}$) for estimating the value of the symbol (b_k) sent by each said user (k).

60. (Previously Presented) The apparatus of claim 34, wherein said wireless communication channel comprises an Ultra Wideband (UWB) communication channel.

61. (Previously Presented) An apparatus for processing a signal, comprising:

means for receiving a signal (y(t)) over a wireless communication channel; and

means for sampling the received signal (y(t)) with a sampling frequency (f_s) lower than the sampling frequency given by the Shannon theorem, lower than the chip rate ($1/T_c$) of said received signal (y(t)), but greater than the rate of innovation (ρ) of said received signal (y(t)), for generating a set of sampled values ($y(nT_s)$).

62. (Previously Presented) A mobile station for wireless communication, comprising:

at least one antenna; and

a receiver configured to receive a signal (y(t)) over a wireless communication channel via the at least one antenna, and sample the signal (y(t)) with a sampling frequency (f_s) lower than the sampling frequency given by the Shannon theorem, lower than the chip rate ($1/T_c$) of said received signal (y(t)), but greater than the rate of innovation (ρ) of said received signal (y(t)), for generating a set of sampled values ($y(nT_s)$).